

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

REMARKS

In the Office Action, the Examiner reviewed claims 1-25 of the above-identified US Patent Application, with the result that all of the claims were objected to and rejected under 35 USC §103. In response, Applicants have amended the specification and claims as set forth above. More particularly:

The specification has been amended to update the status of U.S. Patent Application Serial No. 09/543,956 to Wang et al., which issued as U.S. Patent No. 6,444,335 after the filing of the present application, and to properly identify U.S. Patent Application Serial No. 09/299,418 as U.S. Patent No. 6,299,988 to Wang et al.

The specification has been amended at paragraphs [0025] and [0026] to delete the reference number "24," which does not appear in the drawings.

Independent claims 1 and 14 and dependent claim 9 have been amended in accordance with the Examiner's suggestion to use "yttria-stabilized zirconia" for "YSZ" and "barium-strontium-aluminosilicate" for "BSAS" where these materials are first introduced in the claims, and indicate their abbreviations ("YSZ" and "BSAS") for subsequent use in the claims.

Independent claims 1 and 14 have been further amended to specify that the transition layer 120 ("second ceramic" layer in claim 1; "third layer" in claim 14) has a coefficient of thermal expansion lower than the YSZ topcoat 122 ("YSZ-containing ceramic layer" in claim 1). Support for these amendments can be found in Applicants' specification at paragraphs [0004], [0005], [0020], and [0023], where YSZ is disclosed

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

as having a CTE (about 10 ppm/°C) greater than mullite (about 5.5 ppm/°C; see paragraph [0004]) and greater than BSAS (about 5.27 ppm/°C; see paragraph [0020]), resulting in the YSZ topcoat 122 having a higher CTE than the YSZ/mullite or YSZ/BSAS transition layer (see paragraphs [0005] and [0023]).

Independent claim 1 has also been amended to incorporate the limitations of its dependent claim 4, namely, the second ceramic layer (120 in Figure 1) has a composition consisting essentially of either YSZ and mullite or YSZ and an alkaline-earth metal aluminosilicate. In view of the amendment to claim 1, claim 4 has been amended to specify that the second ceramic layer (120) is a mixture "consisting of" either YSZ and mullite or YSZ and an alkaline-earth metal aluminosilicate.

Finally, dependent claims 16 and 18 have been amended for consistency with respect to the use of the abbreviation "YSZ" for yttria-stabilized zirconia.

Applicants believe that the above amendments do not present new matter. Favorable reconsideration and allowance of claims 1-25 are respectfully requested in view of the above amendments and the following remarks.

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

Objection to the Claims

The Examiner objected to the claims for the manner in which the abbreviations "YSZ" and "BSAS" were used. Applicants have amended the claims in accordance with the Examiner's suggestion as indicated above, and therefore respectfully request withdrawal of the objection to the claims.

Rejections under 35 USC §103

Independent claims 1 and 14 and their dependent claims 2-13 and 15-25 were rejected under 35 USC §103(a) as being unpatentable over EP 1 142 850 A1 to Wang et al. in view of U.S. Patent No. 6,180,184 to Gray et al. (Gray), and also as being unpatentable over U.S. Patent No. 6,444,335 to Wang et al. in view of Gray. Applicants respectfully traverse each of these rejections in view of the following comments.

As a preliminary matter, EP 1 142 850 A1 to Wang et al. claims priority to U.S. Patent Application Serial No. 09/543,956, which issued as U.S. Patent No. 6,444,335 to Wang et al. For the convenience of the following discussion, these references will be treated as the "Wang" reference.

Applicants' invention is directed to a process for depositing a multilayer ceramic coating system (112) on a substrate (110), which is preferably a silicon-containing material such as a SiC/SiC ceramic matrix composite (CMC). The coating system (112) has a vertically-cracked YSZ-containing ceramic topcoat (122) that is

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

deposited on a transition layer (120) having a composition different than the YSZ-containing ceramic topcoat (122), namely, a mixture of YSZ and mullite or a mixture of YSZ and an alkaline-earth metal aluminosilicate (preferably BSAS), with the result that the transition layer (120) has a lower CTE than the topcoat (122). According to Applicants' teachings, such a coating system is prone to the development of horizontal cracks in the transition layer (120) and topcoat (122). As a solution, Applicants teach depositing the YSZ-containing topcoat (122) using a plasma spraying technique while maintaining the substrate (110) at a temperature of not greater than about 600°C, and more preferably not higher than about 450°C if the transition layer (120) is formed of YSZ and BSAS, and not higher than about 550°C if the transition layer (120) is formed of YSZ and mullite.

Under each of the §103 rejections, the Examiner cited Wang for disclosing the composition of the coating system (112) deposited by Applicants' claimed process, while acknowledging that Wang fails to specifically teach "the YSZ top layer is a dense, strain-tolerant, vertically cracked layer applied while maintaining the substrate at a specific temperature." The Examiner then cited Gray for disclosing a process for depositing "a thermal barrier coating with a coherent, continuous columnar microstructure" that "is desirably a yttria stabilized zirconia (YSZ)," "applied to a bond coating on a substrate," and "applied by a plasma spraying process." Finally, the Examiner described Gray as teaching that "the temperature of the deposition surface should be controlled during spraying to provide the desired microstructure, with the

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

temperature, when applying YSZ thermal barrier coatings, being above about 300 degrees C."

As noted above, Applicants teach and claim a process in which a ceramic YSZ-containing topcoat (122) is deposited directly on a ceramic YSZ-mullite or YSZ-BSAS transition layer (120), resulting in a CTE mismatch in which the topcoat (122) has a higher CTE than the transition layer (120) on which it is directly deposited. In contrast, Gray teaches a process in which a ceramic layer 58 (the example given is YSZ) is initially deposited directly on a bond coat 56 (the example given is an MCrAlY metallic bond coat), and thereafter multiple ceramic layers 58 with identical compositions are deposited directly on the preceding ceramic layer 58 to build up a coating system 50. As such, the only CTE mismatch that exists in Gray's coating system 50 is between the first ceramic layer 58 and the bond coat 56, in which case the first ceramic layer 58 has a lower CTE than the bond coat 56 (because YSZ has a lower CTE than a metallic bond coat). In other words, Gray does not attempt to deposit a ceramic layer on a second ceramic layer, wherein the result is a CTE mismatch in which the first ceramic layer has a higher CTE than the ceramic layer on which it is directly deposited. Consequently, Applicants have confronted and solved a problem that is neither confronted nor solved by Gray.

In view of the above, Applicants believe that there is no motivation to combine the teachings of Wang and Gray. First, neither Wang nor Gray recognize the horizontal crack problem solved by Applicants through Applicants' recognition of the

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

particular CTE mismatches within coating systems of the type taught by Wang.

Second, because the CTE combinations within Gray's coating system 50 are different from those of Wang (and Applicants'), Gray would not suggest to those of ordinary skill in the art that they should carry out Gray's (or Applicants') process to deposit Wang's (or Applicants') coating system, and Gray provides no basis for a reasonable expectation of success to deposit Wang's coating system in accordance with Gray's process, as required by MPEP §2143.02¹. It is only through Applicants' teachings that one would realize that lower deposition temperatures have a beneficial effect on a coating system of the type taught by Wang.

For all of the above reasons, Applicants respectfully request withdrawal of the rejections of the claims under 35 USC §103.

¹ See *In re Vaeck*, 20 USPQ2D 1438 (Fed. Cir. 1991), which restated the criteria for obviousness as follows:

Where the claimed subject matter has been rejected as obvious in view of a combination of prior art references, a proper analysis under §103 requires, inter alia, consideration of two factors: (1) whether the prior art would have suggested to those of ordinary skill in the art that they should make the claimed composition or device, or carry out the claimed process; and (2) whether the prior art would also have a reasonable expectation of success. . . . Both the suggestion and the reasonable expectation of success must be founded in the prior art, not in the applicant's disclosure. (Emphasis supplied).

20 USPQ2D at 1442.

Application No. 10/063,967
Docket No. 17MY-7127
Amendment dated September 8, 2003
Reply to Office Action of June 6, 2003

Closing

In view of the above, Applicants believe that all their claims define patentable novelty over all the references, alone or in combination, of record. It is therefore respectfully requested that this patent application be given favorable reconsideration.

Should the Examiner have any questions with respect to any matter now of record, Applicants' representative may be reached at (219) 462-4999.

Respectfully submitted,

By *Domenica N. S. Hartman*
Domenica N.S. Hartman
Reg. No. 32,701

September 8, 2003
Hartman & Hartman, P.C.
Valparaiso, Indiana 46383
TEL.: (219) 462-4999
FAX: (219) 464-1166

OFFICIAL

RECEIVED
CENTRAL FAX CENTER
SEP 09 2003